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Characteristics, Detection Methods and Treatment of Questionable Occlusal Carious Lesions: Findings from The National Dental Practice-Based Research Network

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Key Words
Clinical research · Dental caries · Multicenter studies · Practice-based research · Questionable lesions

Abstract
Questionable occlusal carious lesions (QOC) can be defined as an occlusal tooth surface with no cavitation and no radiographic radiolucencies, but caries is suspected due to roughness, surface opacities or staining. An earlier analysis of data from this study indicates 1/3 of patients have a QOC. The objective of this report has been to quantify the characteristics of these common lesions, the diagnostic aids used and the treatment of QOC. A total of 82 dentist and hygienist practitioner-investigators from the USA and Denmark in the National Dental Practice-Based Research Network participated. When consenting patients presented with a QOC, information was recorded about the patient, tooth, lesion and treatments. A total of 2,603 QOC from 1,732 patients were analyzed. The lesions were usually associated with a fissure, on molars, and varied from yellow to black in color. Half presented with a chalky luster and had a rough surface when examined with an explorer. There was an association between color and luster: 10% were chalky-light, 47% were shiny-dark and 42% were mixtures. A higher proportion of chalky than of shiny lesions were light (22 vs. 9%; $p < 0.001$). Lesions light in color were less common in adults than in pediatric patients (9 vs. 32%; $p < 0.001$). Lesions that were chalky and light were more common among pediatric than among adult patients (22 vs. 6%; $p < 0.001$). This is the first study to investigate characteristics of QOC in routine clinical practice. Clinicians commonly face this diagnostic uncertainty. Determining the characteristics of these lesions is relevant when making diagnostic and treatment decisions.

The National Dental PBRN Collaborative Group comprises practitioner-investigators, faculty investigators and staff members who contributed to this activity. A list of these persons is at http://www.nationaldentalpbrn.org/collaborative-group.php.

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Despite considerable improvements in oral health [Brown et al., 2000], dental caries remains a significant health problem [NHANES III, 1996] that is experienced by more than 90% of all United States dentate adults and more than 2/3 of all children, with a wide range of severity [Kaste et al., 1996; Winn et al., 1996]. With the advent of fluoride [Lussi, 1993; Basting and Serra, 1999; White and Eakle, 2000; Pitts, 2004] the incidence of caries in the overall population has lessened in recent years. The effects of fluoride, though, have led to difficulty in detecting carious lesions on the occlusal surface because fluoride can result in an intact surface with subsurface demineralization [Lussi, 1993; Hamilton et al., 2001], which can lead to changes in the physical appearance of these carious lesions [Pine and Bosch, 1996]. There are essentially two types of such lesions. In 'hidden caries', demineralization has progressed to the point where it is detectable radiographically. In 'questionable occlusal carious lesions (QOC)', which are the focus of this study, the tooth has no cavitation and no radiographic evidence of caries, but the presence of a carious lesion is suspected due to roughness, surface opacities or staining. Such QOC lesions may be difficult to detect [Sawle and Andlaw, 1988; Ketley and Holt, 1993; Pine and Bosch, 1996; Pitts, 1997; Ouellet et al., 2002].

Questionable lesions present practitioners with a difficult diagnostic decision [Lussi, 1993; Kidd et al., 1993; Pine and Bosch, 1996; Weerheijm, 1990]. To date there have been very few studies regarding the characteristics, management and treatment of these lesions [Meiers and Jensen, 1984; Sawle and Andlaw, 1988; Ketley and Holt, 1993; Hamilton et al., 2001; Ouellet et al., 2002], and only one examining their progression [Hamilton et al., 2002]. As a result there is no consensus on their management. However, the relatively slow progression of occlusal carious lesions in general [Ketley and Holt, 1993; Balevi, 2008], coupled with the possibility of their arrest or reversal, and the success of sealants and fluoride in stopping the progression of frank dentinal carious lesions (caries that is clearly in the dentin, either seen clinically or radiographically), all argue for a conservative approach [Groeneveld et al., 1990; Bader and Shugars, 2006; Frencken et al., 2012]. Ismail et al. [2001] found that although general dentists spend a bulk of their time restoring lesions, there is a growing interest in the preventive aspects of managing these lesions. If more evidence is gathered regarding the characteristics of these lesions as well as the treatment outcomes, dentists will be able to help their patients manage their oral health by nonsurgical means, which can lead to an impact on daily clinical practice [Kidd and Nyvad, 2003].

Given the scarcity of well-conducted studies that support this recommendation about clinical management, it is clear that more needs to be known about the epidemiology of QOC. An earlier analysis of data from this study indicates that among patients attending dental practices affiliated with the National Dental Practice-Based Research Network (PBRN), an overall patient prevalence of 34% was observed [Makhija et al., 2012]. Because of this relatively high prevalence, clinicians may benefit from a careful description of the characteristics of these lesions. The purpose of this study was to determine the characteristics of these lesions, the diagnostic aids used and the treatment of these lesions found in general and pediatric practice settings.

Material and Methods

The National Dental PBRN

We conducted this study on patients visiting dental practices affiliated with the National Dental PBRN. The network is a consortium of dental practices, established to answer questions raised by dental practitioners in everyday clinical practice and to evaluate the effectiveness of strategies to prevent, manage and treat oral diseases and conditions [Gilbert et al., 2008; Makhija et al., 2009]. The network includes dental health care personnel (general dentists, dental specialists and hygienists). At the time of this study, the network mainly comprised 5 geographic regions:

- Alabama/Mississippi (AL/MS);
- Florida/Georgia (FL/GA);
- Minnesota (MN), encompassing dentists either employed by HealthPartners (Minnesota) or in private practice;
- Permanente Dental Associates (PDA), in cooperation with Kaiser Permanente's Center for Health Research (Oregon and Washington); and
- Scandinavia, encompassing Denmark (DK), Norway and Sweden, although in this study only Denmark participated.

The network represents dentists and hygienists who are diverse with regard to practice type (solo and small group practice, large group practice, public health practice), treatment philosophy, race, ethnicity, workload, age and sex. The AL/MS and FL/GA regions mainly comprised solo and small group practices (3 dentists or fewer). The MN region mainly comprised solo and large group practices (4 dentists or more). The DK region comprised dentists and hygienists in small and solo group practices as well as public health practices.

Although the network dentists have substantial diversity, previous analyses have documented that network dentists have much in common with dentists at large [Makhija et al., 2009]. At the time of this study, more than 1,000 practitioners, including 68 hygienists, were enrolled in the network. Specifics regarding network practitioners have been reported previously [Makhija et al., 2009].

Selection and Recruitment Process

Network practitioners were recruited by regional coordinators through continuing dental education courses sponsored by the network, as well as via letters sent to licensed practitioners from the participating regions. To be eligible for this study, practitio-

ners had to complete both the enrollment questionnaire and a questionnaire regarding how they diagnose and treat dental caries (Assessment of Caries Diagnosis and Caries Treatment questionnaire; http://nationaldentalpbrn.org/study-results.php), attend an orientation session or watch a video of it, and complete their training in human subject protection. To become a member of the network, practitioners must first complete an enrollment questionnaire. This questionnaire, which is publicly available at http://nationaldentalpbrn.org/enrollment.php, collects information about practitioner, practice and patient characteristics.

Study Design

The data were collected by network dentists and hygienists (practitioners) in their offices. As previously reported [Makhija et al., 2012], participating practices maintained a consecutive patient log of patients presenting with unrestored occlusal surfaces for approximately 100 patients. If a patient presented with a QOC, met the requirement of having a radiograph no older than 6 months, and consented to participate in the study, the practitioner filled out a data collection form (up to 2 lesions could be enrolled per patient). The data collection form included specific information about the patient and lesion. Practices were asked to enroll approximately 25 lesions. Copies of the data collection forms are available at http://nationaldentalpbrn.org/study-results.php.

After the offices completed the initial data collection phase of the study, radiographs for 5 randomly selected patients with digital radiographs were chosen for each office and sent to an independent reviewer (to alleviate any concerns about conflicts of interest), so verification could be provided that no occlusal carious lesions were present. If the presence of a radiolucency indicated a carious lesion within the occlusal enamel or within underlying dentin, the lesion would not have been enrolled. During the review process, however, no radiographs from any office were deemed to have disclosed radiographic evidence of occlusal carious lesions.

Statistical Methods

The (1) practitioners/practices and patient characteristics, (2) lesion characteristics, (3) diagnostic aids used, (4) treatments, (5) clinical findings and (6) materials used in case of invasive treatments are described overall and by region (tables 1–3). χ^2 tests were used for initial assessments of the significance of differences in these variables across regions. Generalized linear models were used to adjust statistical significance for clustering within practices. The following outcomes were determined: (1) associations between characteristics and methods of diagnosis, and (2) association of methods of diagnosis with treatment.

Separate models were run for each diagnostic aid assessed (outcome), i.e. dental explorer, air drying, magnification and radiographs. Primary analysis regarding treatment was whether or not treatment was invasive. For these analyses, enameloplasty, preventive resin restoration and full restoration were combined and classified as 'invasive' (tooth structure was removed). Associations with full restorations (lesions treated by enameloplasty or preventive resin restoration were excluded) were also assessed, and associations with enameloplasty, excluding lesions treated with preventive resin or full restorations.

For each analysis, a full model and a reduced model were fit. Full models assessing associations with diagnostic aids included: region; whether or not the patient was pediatric (age ≤18 years); tooth type (molar/premolar); lesion luster; and color. For associations with treatments, diagnostic aids used were also included. Practice and practitioner characteristics were assessed, but after accounting for clustering within practice, most models would not run (insufficient cluster size, variation within clusters); exceptions are noted. Backward elimination was used to fit reduced models; namely, variables were removed one at a time, leaving only variables with $p < 0.05$ in the model. Odds ratios (OR) and 95% confidence intervals (CI) were calculated from the models. All analyses were performed with SAS® version 9.1.

A total of 2,670 lesions (1,765 patients) were enrolled in the study. A total of 67 lesions (33 patients) were excluded due to missing data on: patient age (n = 1); luster (n = 11); color (n = 34); color classified as 'other' (n = 24); and no indication of treatment options (n = 9). This left 2,603 lesions (1,732 patients) for analysis. A higher proportion of lesions from Southeast USA (AL/MS and FL/GA) than from elsewhere were excluded [5% (54/1,154) vs. 1% (13/1,516); $p < 0.001$] and had received invasive treatment [8% (30/379) vs. 1.6% (37/2,291); $p < 0.001$].

The respective institutional review boards in each region approved the study and all patients provided informed consent after dentists or their staff provided them with a full explanation of the nature of the procedures. The informed consent of all human subjects who participated in this investigation was obtained after the nature of the procedures had been fully explained.

Results

Practices/Practitioners and Patients

A total of 70 dentists from the USA and DK and 12 Danish dental hygienists collected the data (table 1). Of the 82 participating practices, 13 were pediatric practices, 34 practitioners were female, 69 were non-Hispanic white, and 27 had graduated 1990 or later. The mean numbers of patients and lesions enrolled per practice were 21 and 32, respectively. All of these characteristics differed by region, notably the proportion of pediatric practices (30–33% for AL/MS and DK, none in MN, and only 1, <7%, in the other 2 regions), and the PDA region enrolled fewer patients and lesions per practice than did the other regions.

The mean age (± SD) of patients was 33 ± 18 years (range: 5–92 years) and 27% were pediatric (≤18 years old). Overall, 47% were male, 70% were white, and 90% had some form of dental insurance. These values did not differ across regions after adjusting for clustering within practices.

Lesions/Tooth

Overall, 69% of the lesions involved molars, 52% were on mandibular teeth, 49% presented with a chalky luster, 15% were light (yellow or light brown) in color, and 455 had a rough texture (table 2). There was an association between color and luster, with a higher proportion of chalky than shiny lesions that were light [22% (274/1,266) vs. 9% (115/1,337); adjusted for clustering OR = 2.2 (95%

Table 1. Practice/practitioner and patient characteristics by region*

	AL/MS (n = 10)	FL/GA (n = 20)	MN (n = 13)	PDA (n = 15)	DK (n = 24)	All (n = 82)	p
Practice/practitioner							
Practice type							
General	7 (70)	19 (95)	13 (100)	14 (93)	16 (67)	69 (84)	*0.02*
Pediatric	3 (30)	1 (5)	0 (0)	1 (7)	8 (33)	13 (16)	
Gender							
Male	8 (80)	16 (80)	8 (62)	10 (67)	6 (25)	48 (59)	*0.002*
Female	2 (20)	4 (20)	5 (38)	5 (33)	18 (75)	34 (41)	
Race/ethnicity							
Non-Hispanic White	8 (80)	16 (80)	13 (100)	8 (53)	24 (100)	69 (84)	*<0.001*
Other/unknown	2 (20)	4 (20)	0 (0)	7 (47)	0 (0)	13 (16)	
Graduation year							
Before 1980	3 (30)	7 (37)	4 (31)	1 (7)	7 (29)	22 (27)	*0.02*
1980–1989	7 (70)	8 (42)	7 (54)	5 (33)	5 (21)	32 (39)	
1990–1999	0 (0)	3 (16)	0 (0)	1 (7)	4 (17)	8 (10)	
2000 or later	0 (0)	1 (5)	2 (15)	8 (53)	8 (33)	19 (24)	
Missing		1				1	
Mean number of patients ± SD/practice	28±15	23±8	23±8	7±4	25±16	21±13	*<0.001*
Mean number of lesions ± SD/practice	40±17	33±13	33±12	11±9	39±27	32±21	*<0.001*
	AL/MS (n = 282)	FL/GA (n = 462)	MN (n = 295)	PDA (n = 104)	DK (n = 589)	All (n = 1,732)	p
Patients							
Age							
≤18 years	123 (44)	94 (20)	73 (25)	34 (33)	141 (24)	465 (27)	0.2
19–44 years	85 (30)	212 (46)	134 (45)	52 (50)	320 (54)	803 (46)	
45 years or older	74 (26)	156 (34)	88 (30)	18 (17)	128 (22)	464 (27)	
Gender							
Male	114 (41)	234 (51)	126 (43)	41 (39)	297 (51)	812 (47)	0.7
Female	168 (59)	228 (49)	168 (57)	63 (61)	290 (49)	917 (53)	
Missing		–	1	–	2	0.3	
Race/ethnicity							
Non-Hispanic White	200 (71)	282 (61)	187 (63)	80 (77)	459 (78)	1,207 (70)	0.3
Other/unknown	82 (29)	181 (39)	108 (37)	24 (23)	130 (22)	525 (30)	
Any dental insurance							
Yes	253 (90)	347 (75)	268 (91)	100 (96)	588 (100)	1,556 (90)	non-estimated
No	29 (10)	114 (25)	27 (9)	4 (4)	–	174 (10)	
Missing	–	1	–	–	1	2	

Values in parentheses denote percentages unless specified otherwise. * At the time of the study, the National Dental PBRN mainly comprised these 5 geographic regions. AL/MS = Alabama/Mississippi; FL/GA = Florida/Georgia; MN = Minnesota; PDA = Permanente Dental Associates; DK = Denmark (Scandinavia).

CI: 1.5–3.3); p < 0.001]. Additionally, lesions light in color were more common in pediatric than in adult patients. Considering color-luster combinations, 10% were chalky-light, 47% were shiny-dark, and 42% were mixtures. Lesions that were a combination of chalky and light were more commonly found among pediatric than among adult patients [22% (152/693) vs. 6% (122/1,910); adjusted for clustering OR = 2.9 (95% CI: 1.9–4.4); p < 0.001].

Diagnostic Aids

Dental explorers and air drying were used in diagnosing the vast majority of lesions – at 91 and 94%, respectively – while magnification and radiographs were each used in diagnosing less than half of the lesions overall (table 2). Use of magnification ranged from 9% in DK to 85% in MN; use of radiographs ranged from 30% in Southeast USA (AL/MS and FL/GA) to 64% in MN.

Table 2. Tooth, lesion, diagnostic and treatment characteristics by region*

	AL/MS (n = 398)	FL/GA (n = 665)	MN (n = 435)	PDA (n = 166)	DK (n = 939)	All (n = 2,603)	p[a]
Tooth/lesion							
Molar	255 (64)	427 (64)	311 (72)	129 (78)	673 (72)	1,795 (69)	0.13
Mandible	226 (57)	324 (49)	230 (53)	84 (51)	495 (53)	1,359 (52)	0.15
Chalky luster	132 (33)	205 (31)	199 (46)	96 (58)	634 (68)	1,266 (49)	*0.01*
Light color	89 (22)	67 (10)	36 (8)	36 (22)	161 (17)	389 (15)	0.06
Rough texture[b]	233 (60)	255 (41)	175 (41)	115 (71)	392 (52)	1,170 (45)	0.12
Luster-color							
Chalky-light	54 (14)	35 (5)	24 (6)	26 (16)	135 (14)	274 (11)	
Shiny-dark	231 (58)	428 (64)	224 (52)	60 (36)	279 (30)	1,222 (47)	
Mixture	113 (28)	202 (30)	187 (43)	80 (48)	525 (56)	1,107 (43)	
Diagnostic aids							
Dental explorer	391 (99)	622 (94)	428 (98)	162 (98)	758 (81)	2,362 (91)	0.08
Air drying	364 (92)	612 (92)	379 (87)	157 (95)	935 (100)	2,448 (94)	*0.02*
Magnification	231 (58)	438 (66)	368 (85)	87 (52)	87 (9)	1,211 (47)	*<0.001*
Radiographs	122 (31)	196 (30)	277 (64)	77 (46)	430 (46)	1,102 (42)	*0.05*
Treatment – mutually exclusive categories							*<0.001*
Monitoring, education and fluoride	257 (65)	495 (75)	311 (72)	20 (12)	744 (79)	1,827 (70)	
Sealant/varnish	51 (13)	31 (5)	91 (21)	58 (35)	187 (20)	418 (16)	
Invasive	87 (22)	138 (21)	29 (7)	88 (53)	7 (1)	349 (14)	

Values in parentheses denote percentages unless specified otherwise. * At the time of the study, the National Dental PBRN mainly comprised these 5 geographic regions. AL/MS = Alabama/Mississippi; FL/GA = Florida/Georgia; MN = Minnesota; PDA = Permanente Dental Associates; DK = Denmark (Scandinavia).

[a] Adjusted for clustering.

[b] Among where dental explorer was used; missing for 4 teeth (2 in AL/MS and 2 in MN).

Table 3. Materials used and findings among lesions treated invasively, by region*

	AL/MS (n = 398)	FL/GA (n = 665)	MN (n = 435)	PDA (n = 166)	DK (n = 939)	All (n = 2,603)
Findings						
No lesions	5 (7)	23 (17)	3 (18)	26 (30)	0 (0)	57 (18)
Inactive lesions	1 (1)	12 (9)	0 (0)	21 (24)	0 (0)	34 (10)
Active lesions	70 (92)	103 (75)	14 (82)	21 (47)	7 (100)	235 (72)
Among active lesions						
Enamel	6 (9)	39 (38)	1 (7)	17 (42)	6 (86)	69 (29)
Dentin	64 (91)	64 (62)	13 (93)	24 (59)	1 (14)	166 (71)
Missing information	11	0	12	0	0	23
Material used						
Amalgam	7 (9)	7 (5)	8 (47)	8 (9)	0 (0)	30 (9)
Composite	72 (89)	122 (91)	6 (35)	32 (38)	7 (100)	239 (74)
Glass ionomer	2 (3)	1 (1)	0 (0)	10 (12)	0 (0)	13 (4)
Other	0 (0)	4 (3)	3 (18)	35 (41)	0 (0)	42 (13)
Missing information	6	4	12	3	0	25

Values in parentheses denote percentages unless specified otherwise. Column totals not summing up to the total treated invasively are due to missing data on findings and/or materials used. In AL/MS, 11 lesions treated invasively had missing data on findings, and 12 in MN. For materials used, 6 lesions had missing information in AL/MS, 4 in FL/GA, 12 in MN and 3 in PDA. * At the time of the study, the National Dental PBRN mainly comprised these 5 geographic regions. AL/MS = Alabama/Mississippi; FL/GA = Florida/Georgia; MN = Minnesota; PDA = Permanente Dental Associates; DK = Denmark (Scandinavia).

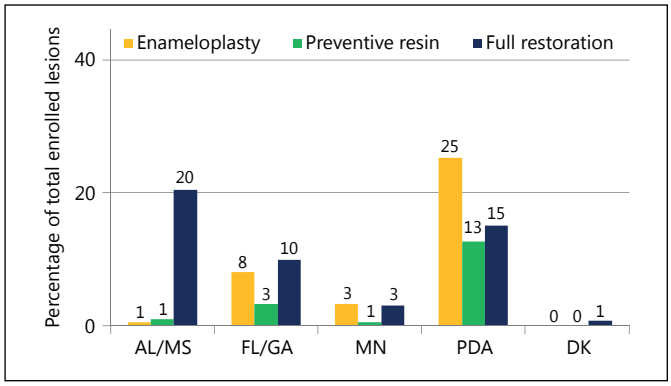

Fig. 1. Type of invasive treatment by region.

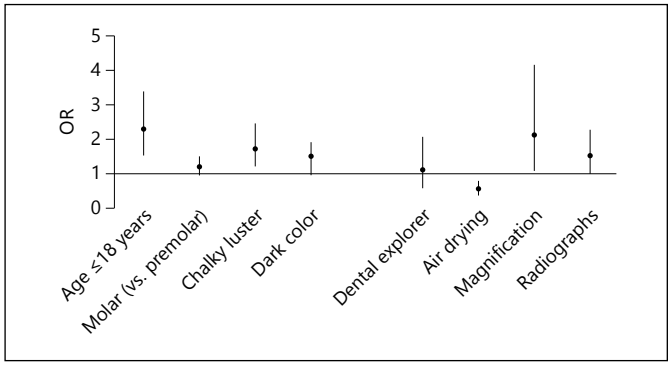

Fig. 2. Patient, tooth and lesion characteristics and diagnostic aids associated with receipt of invasive treatment for QOC (n = 326).

Use of Diagnostic Aids

After accounting for clustering within practice, no patient, tooth or lesion characteristic was associated with use of dental explorer. No patient, tooth or lesion characteristic was associated with use of air drying, but air drying was used more in pediatric than in general practices. Chalky luster was associated with a small increase in use of radiographs (OR = 1.2; 95% CI: 1.0–1.4; p = 0.02; full model). A model including all regions could not be fit for magnification because of cluster size, number and lack of variation within the cluster. Excluding DK, a model was fit; pediatric patient (OR = 0.8; 95% CI: 0.7–1.0; p = 0.04) and light color (OR = 0.8; 95% CI: 0.7–1.0; p = 0.04) were each associated with a small reduction in use of magnification.

Treatments

Overall, 70% of lesions were treated solely with monitoring, education or fluoride, 16% with sealant or varnish, and 14% with some type of invasive treatment (table 2). Enameloplasty was used for 112 of the 349 lesions treated with an invasive procedure, preventive resin restorations for 49 lesions, and full restoration for 192 lesions. Treatment method varied considerably across regions, particularly invasive treatment, which varied from 1% in DK to 53% in PDA. Type of invasive restoration procedure also varied across regions (fig. 1): use of enameloplasty ranged from 0% in DK to 25% in PDA, use of preventive resin restoration from 0% in DK to 13% in PDA, and use of full restorations from 1% in DK to 20% in AL/MS.

Clinical Findings/Materials Used

There were data on clinical findings for 326 of the 349 lesions treated invasively (table 3). No caries was observed in 18% of these lesions, inactive caries in 10%, and active caries in 72%. This differed by type of invasive treatment: among those treated by enameloplasty, 28% (28/101) had active caries; 66% (29/44) had preventive resin restoration, and 98% (178/181) had full restoration. As with clinical findings, materials used for restoration depended largely on type of treatment and findings. As can be seen in table 3, composite was the restorative material used for treatment of 74% of the lesions, amalgam for 9% and glass ionomer for 4% of the lesions.

Use of Invasive Treatment

After adjusting for clustering within practice, no practice or practitioner characteristic was associated with type of invasive treatment. In full models, pediatric patient, chalky luster and use of magnification were associated with an increased likelihood of invasive treatment (fig. 2). Removing nonsignificant variables (reduced model) had no discernible effect on findings compared with the full model: no additional variables became significant, the variables significant in the full model remained so, and the magnitude of association was similar. In PDA, in which 25% of the lesions were treated by enameloplasty, there were no significant predictors, nor were there in the AL/MS region. In MN (3% were treated by enameloplasty), however, being a 'pediatric' patient was strongly associated with enameloplasty (OR = 19.5; 95% CI: 5.3–71.7; p < 0.001) and having a chalky luster was strongly associated with not being treated by enameloplasty (OR = 0.1; 95% CI: 0.01–0.77; p = 0.03).

Discussion

Dental care has slowly evolved from a time of restoring all carious lesions, regardless of size, to 'early detection and management' [Bader and Shugars, 2006]. Hamilton

et al. [2002] studied 223 QOC in a randomized trial comparing air abrasion with monitoring over a 2-year observation period. Only 16% (n = 100) of the lesions randomized to the monitoring arm progressed into the dentin by the end of the 2-year observation period, showing that conservation of the tooth structure is possible and that operative intervention for QOC is not recommendable.

In Western countries, 40% of restorations are placed on primary carious lesions – generally smaller lesions – which can lead to overtreatment [Browning and Dennison, 1996]. Information gathered on these smaller lesions can lead to cost-effective health care delivery and reduce unnecessary treatment [Browning and Dennison, 1996; Verdonschot et al., 1999]. A recent study on dentin caries activity in early occlusal lesions concluded that sealing of early or shallow occlusal lesions would be more beneficial to the patient than operative treatment [Lehmann et al., 2012]. A pilot study conducted by Miller et al. [1995] opened 8 'potentially' carious tooth surfaces (light or dark brown discoloration or white inside the pit and softness when an explorer was passed over the pit) and found that 5 of the 8 only had a stain and only 3 had carious lesions, but these were limited to the enamel, meaning preventive measures would have been appropriate for all 8 teeth. Another study, conducted by Ekstrand et al. [1997], looked at 100 occlusal surfaces for the purpose of investigating the accuracy of a visual ranked caries scoring system, an electronic caries scoring system, and a radiographic ranked caries scoring system. The authors concluded there was a high correlation between the visual and electronic caries scoring system methods and lesion depth in both enamel and dentin, but they found that caries limited to the enamel could not be detected through radiographic examination.

Another, more recent, study by Ekstrand et al. [2007] tested the accuracy of the ICDAS I and ICDAS II caries detection systems for assessing occlusal carious lesion activity. They concluded that it was possible to predict the lesion depth and assess the activity of these lesions accurately by using visual appearance, location of the lesion, and tactile sensation during probing.

There are some limitations to this study. It investigated diagnosis and treatment as delivered in routine, 'real-world' clinical practice and therefore made no attempt to standardize or calibrate that diagnosis or treatment. Each practice was trained specifically for this study so as to standardize the data collection process, but no effort was made to standardize diagnostic or treatment methods for QOC – indeed, such standardization would not be desirable because an objective of the study was to determine the distribution of the characteristics of these lesions given the diagnostic methods which they normally use in routine practice.

It is interesting to note that as age increased, the number of QOC found on molars decreased. This could be due to the fact that these surfaces may already have had restorations or sealants placed on them at a younger age [Dye and Thornton-Evans, 2010]. Another reason could be that dentists tend to treat occlusal surfaces in older patients less aggressively because, presumably, these 'lesions' have been there and not progressed. The results also illustrate that color of the lesion changed as age increased on both molars and premolars, with opaque-to-white lesions decreasing as age increased, reflecting the natural development of occlusal carious lesions over time. The regression analyses performed also indicate that practitioners did not distinguish between the color-and-luster combined categories when making their treatment decisions. The Hamilton study found a strong correlation between fissure color (light brown and dark brown fissures had more caries penetrating the dentin compared with tooth-colored or yellow-orange fissures) and fissure feel (retention at baseline led to the tooth more likely being treated for caries within a 24-month period) [Hamilton et al., 2002]. This information is important when diagnosing and treating QOC in daily clinical practice.

To our knowledge, this is the first study to report the distribution of characteristics of QOC in routine clinical practice. The phenomenon is common (with a prevalence of >30%), and the age of the patient as well as tooth location and characteristics are important factors to be considered when diagnosing these lesions.

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Disclosure Statement

All authors declare no conflicts of interest. The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. The opinions and assertions contained herein are those of the authors and are not to be construed as necessarily representing the views of the respective organizations or the NIH.

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